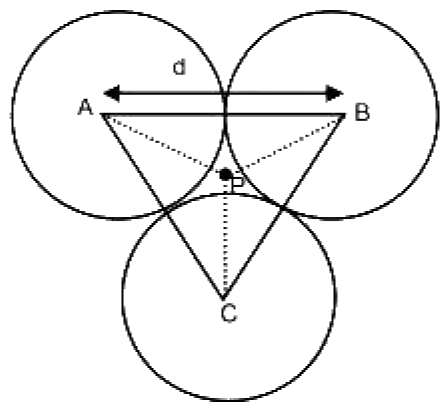
JEE Main 2020 Paper

Date of Exam: **9th January (Shift I)**
Time: **9:30 am – 12:30 pm**
Subject: **Physics**

1. Three identical solid spheres each have mass 'm' and diameter 'd' are touching each as shown in the figure. Calculate ratio of moment of inertia about the axis perpendicular to plane of paper and passing through point P and B as shown in the figure. Given P is centroid of the triangle



a. $\frac{13}{23}$ b. $\frac{11}{19}$
c. $\frac{7}{9}$ d. $\frac{13}{11}$

Solution: (a)

Moment of Inertia of solid sphere $= \frac{2}{5}M\left(\frac{d}{2}\right)^2$

Distance of centroid ($Point\ P$) from centre of sphere $=\left(\frac{2}{3}\times\frac{\sqrt{3}d}{2}\right)=\frac{d}{\sqrt{3}}$

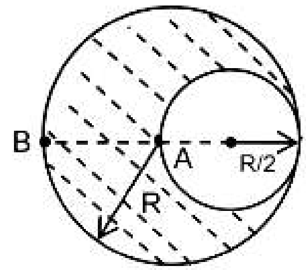
By Parallel axis theorem,

Moment of Inertia about $P = 3\left[\frac{2}{5}M\left(\frac{d}{2}\right)^2 + M\left(\frac{d}{\sqrt{3}}\right)^2\right] = \frac{13}{10}M\,d^2$

Moment of Inertia about $B = 2\left[\frac{2}{5}M\left(\frac{d}{2}\right)^2 + M(d)^2\right] + \frac{2}{5}M\left(\frac{d}{2}\right)^2 = \frac{23}{10}M\,d^2$

Now ratio $= \frac{13}{23}$

2. A sold sphere having a radius R and uniform charge density ρ has a radius R/2 as shown in the figure. Find the ratio of the magnitude of electric field at point A and B



a. $\frac{18}{19}$
b. $\frac{11}{17}$
c. $\frac{9}{17}$
d. $\frac{9}{91}$

Solution: (c)

For solid sphere,

Field inside sphere, E = $\frac{\rho r}{3\epsilon_0}$ & Field outside sphere, E = $\frac{\rho R^3}{3r^2\epsilon_0}$ where, r is distance from centre and R is radius of sphere

Electric field at A due to sphere of radius R (sphere 1) is zero and therefore, net electric field will be because of sphere of radius $\frac{R}{2}$ (sphere 2) having charge density $(-\rho)$

$$E_A = \frac{-\rho R}{2(3\epsilon_0)}$$

$$|E_A| = \frac{\rho R}{6\varepsilon_0}$$

Similarly, Electric field at point $B = E_B = E_{1B} + E_{2B}$

E_{1B} = Electric Field Due to solid sphere of radius $R = \frac{\rho R}{3\varepsilon_0}$

E_{2B} = Electric Field Due to solid sphere of radius $\frac{R}{2}$ which having charge density $(-\rho)$

$$= -\frac{\rho\left(\frac{R}{2}\right)^3}{3\left(\frac{3R}{2}\right)^2\varepsilon_0} = -\frac{\rho R}{54\varepsilon_0}$$

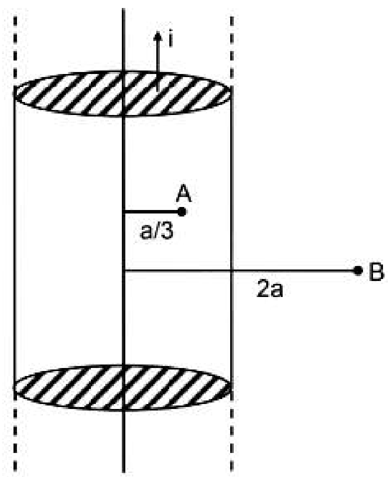
$$E_B = E_{1A} + E_{2A} = \frac{\rho R}{3\varepsilon_0} - \frac{\rho R}{54\varepsilon_0} = \frac{17\rho R}{54\varepsilon_0}$$

$$\frac{|E_A|}{|E_B|} = \frac{9}{17}$$

3. Consider an infinitely long current carrying cylindrical straight wire having radius 'a'. Then the ratio of magnetic field at distance a/3 and 2a from axis of wire is.

a. 3/5
b. 2/3
c. 1/2
d. 4/3

Solution: (b)

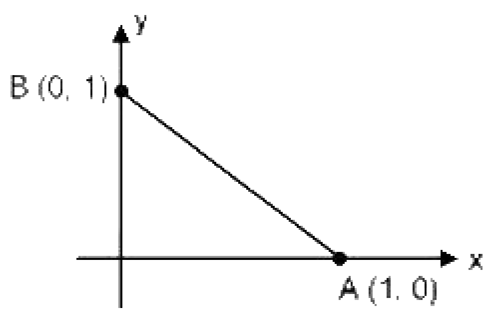


$$B_A = \frac{\mu_0 ir}{2\pi a^2} = \frac{\frac{\mu_0 ia}{3}}{2\pi a^2} = \frac{\mu_0 i}{\pi a^2}\frac{a}{6} = \frac{\mu_0 i}{6\pi a}$$

$$B_B = \frac{\mu_0 i(2a)^2}{2\pi(2a)} = \frac{\mu_0 i}{4\pi a}$$

$$\frac{B_A}{B_B} = \frac{4}{6} = \frac{2}{3}$$

4. Particle moves from point A to point B along the line shown in figure under the action of force. $\bar{F} = -x\,\hat{\imath} + y\,\hat{\jmath}$. Determine the work done on the particle by $\bar{F}$ in moving the particle from point A to point B



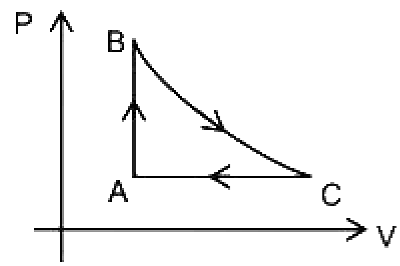
a. 1 J
b. 1/2 J
c. 2 J
d. 3 J

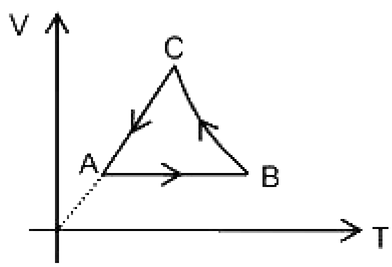
Solution: (a)

$$d\,\vec{s} = (d\,x\,\hat{\imath} + d\,y\,\hat{\jmath})$$
$$= (-x\,\hat{\imath} + y\,\hat{\jmath}).(d\,x\,\hat{\imath} + d\,y\,\hat{\jmath})$$
$$= \int_1^0 -x\,dx + \int_0^1 ydy$$

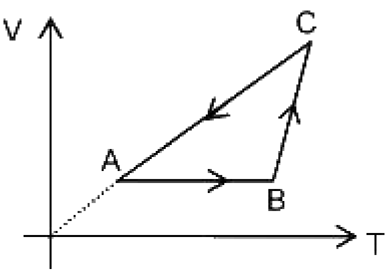
$$= -\frac{x^2}{2}\Big|_1^0 + \frac{y^2}{2}\Big|_0^1 = \frac{1}{2} + \frac{1}{2} = 1\,J$$

5. For the given P -V graph for an ideal gas, chose the correct V -T graph. Process $B\ C$ is adiabatic.

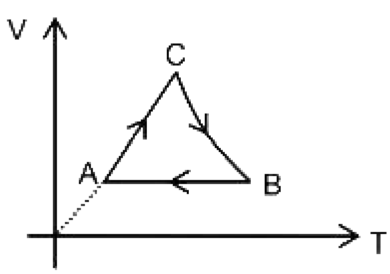




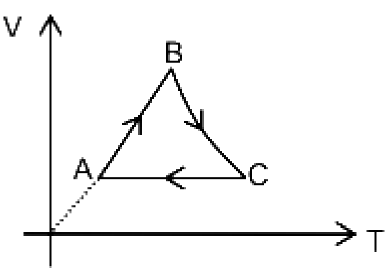
a.



b.



c.



d.

Solution: (a)
For process A—B; Volume is constant;
For process $B - C$, PV^{γ} = Constant & $PV = nRT$, Therefore $TV^{\gamma-1}$ = Constant ;
Therefore as V increases T increases.
For process $C - A$; pressure is constant , Therefore $V = k\,T$
From above, correct answer is option 1.

6. Given, Electric field at point P, $\vec{p} = -\hat{\imath} - 3\,\hat{\jmath} + 2\,\hat{k}$ and $\hat{r} = \hat{\imath} + 3\,\hat{\jmath} + 5\,\hat{k}$. Find vector parallel to electric field at position $\vec{r}$. [Note that $\vec{p}\,.\vec{r} = 0$]

a. $\hat{\imath} + 3\,\hat{\jmath} - 2\,\hat{k}$
b. $3\,\hat{\imath} + \hat{\jmath} + 2\,\hat{k}$
c. $-3\,\hat{\imath} - \hat{\jmath} - 2\,\hat{k}$
d. $-\hat{\imath} + 3\,\hat{\jmath} + 2\,\hat{k}$

Solution: (a)

Since, we have to find vector parallel to electric field at position $\vec{r}$

We have to find $\vec{p}\,.\vec{r} = 0$

Since already in question, $\vec{p}\,.\vec{r} = 0$ is given we need to find E such that

$\vec{E} = \lambda\,(\vec{p})$

where λ is a arbitrary positive constant

On putting , λ = -1 , we get, $\vec{E} = \hat{\imath} + 3\,\hat{\jmath} - 2\,\hat{k}$

7. A particle of mass m is revolving around a planet in a circular orbit of radius R. At the instant the particle has velocity $\vec{V}$, another particle of mass $\frac{m}{2}$ moving at velocity of $\frac{\vec{V}}{2}$ in same direction collides perfectly in-elastically with the first particle. The new path of the combined body will take is

a. Elliptical
b. Circular
c. Straight Line
d. Spiral

Solution: (a)

By conservation of linear momentum

$\frac{m}{2}\frac{V}{2} + mV = (m + \frac{m}{2})V_f$

$V_f = \dfrac{5V}{6}$

Escape velocity will be at $\sqrt{2}V$ and at velocity less than escape velocity path will be elleptical or part of ellipse except for velocity V where path will be circular.

Hence the resultant mass will go on to an elliptical path

8. Two particles of same mass m moving with velocities $\overrightarrow{v_1} = v\,\hat{\imath}$ and and $\overrightarrow{v_1} = \frac{v}{2}\hat{\imath} + \frac{v}{2}\hat{\jmath}$ collide in – elastically. Find the loss in kinetic energy.

a. $\frac{mv^2}{8}$
b. $\frac{1mv^2}{8}$
c. $\frac{9mv^2}{8}$
d. $\frac{3mv^2}{8}$

Solution: (a)

Conserving linear momentum

$mv\,\hat{\imath} + m(\frac{v}{2}\hat{\imath} + \frac{v}{2}\hat{\jmath}) = 2m(v_1\,\hat{\imath} + v_2\,\hat{\jmath})$

By equating $\hat{\imath}$ and ĵ

$v_1 = \frac{3v}{4}$ and $v_2 = \frac{v}{4}$

Initial K.E $= \frac{mv^2}{2} + \frac{m}{2} \times (\frac{v}{\sqrt{2}})^2 = \frac{3mv^2}{4}$

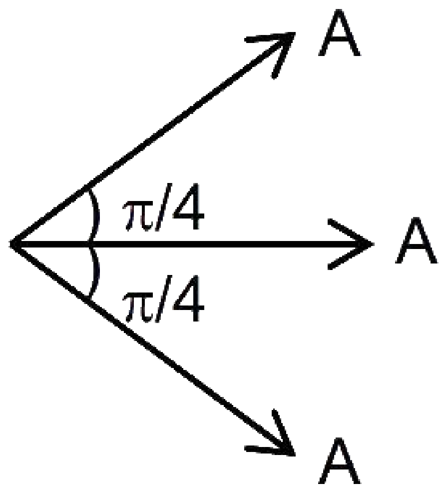
Final K.E $= \frac{2m}{2} \times (\frac{v\sqrt{10}}{4})^2 = \frac{mv^2}{8}$

Change in KE =
$\frac{3mv^2}{4}$ - $\frac{5mv^2}{8} = \frac{mv^2}{8}$

9. Three waves of same intensity (I_0) having initial phases $0, \frac{\pi}{4}, -\frac{\pi}{4}$ rad respectively interfere at a point. Find the resultant intensity.

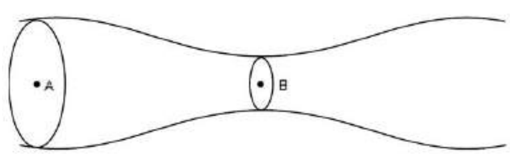
a. $5.8\ I_0$ b. I_0
c. $0.4\ I_0$ d. $0.3\ I_0$

Solution: (a)



Amplitudes can be vectorially added
$A_{resultant} = (\sqrt{2} + 1)A$
Since, I $\propto A^2$
Therefore, $I_{res} = (\sqrt{2} + 1)^2 I_0 = 5.8\ I_0$

10. An ideal liquid (water) flowing through a tube of non-uniform cross section area at A and B are 40 cm^2 and 20 cm^2 respectively. If pressure difference between A & B is 700 N/m^2 then volume flow rate is



a. 2732 cm^3 /s b. 2142 cm^3/s
c. 1832 cm^3/s d. 3218 cm^3/s

Solution: (a)

Using equation of continuity

$V_A \times Area_A = V_B \times Area_B$

$40V_A = 20V_B$

$2V_A = V_B$

Using Bernoulli's equation

$$P_A + \frac{1}{2}\rho V_A^2 = P_B + \frac{1}{2}\rho V_B^2$$

$$P_A - P_B = \frac{1}{2}\rho(V_B^2 - V_A^2)$$

$$\Delta P = \frac{1}{2}1000\left(V_B^2 - \frac{V_B^2}{4}\right)$$

$$\Delta P = 500 \times \frac{3V_B^2}{4}$$

$$V_B = \sqrt{\frac{(\Delta P) \times 4}{1500}} = \sqrt{\frac{(700) \times 4}{1500}} = \sqrt{\frac{28}{15}}\,\mathrm{m/s}$$

Volume flow rate $= V_B \times Area_B = 20 \times 100 \times \sqrt{\frac{28}{15}}\,\mathrm{cm^3/s} = 2732\,\mathrm{cm^3/s}$

11. A screw gauge advances by 3mm in 6 rotations. There are 50 divisions on circular scale. Find least count of screw gauge?

a. 0.002 cm
b. 0.001 cm
c. 0.01 cm
d. 0.02 cm

Solution: (b)

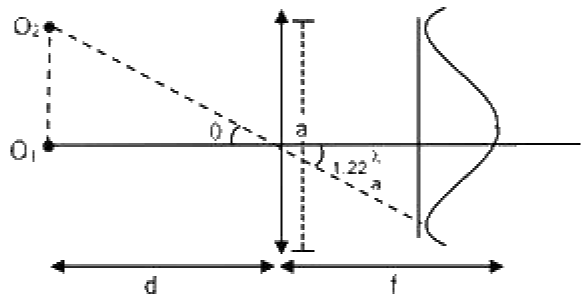
Pitch $= \frac{3}{6} = 0.5$ mm

Least count $= \frac{\text{Pitch}}{\textit{Number of division}} = \frac{0.5\text{mm}}{50} = \frac{1}{100}\,\text{mm} = 0.01\text{ mm} = 0.001\text{ cm}$

12. A telescope of aperture diameter 5m is used to observe the moon from the earth. Distance between the moon and earth is 4×10^5 km. Determine the minimum distance between two points on the moon's surface which can be resolved using this telescope. (Wave length of light is 5893 Å)

a. 60 m
b. 20 m
c. 600 m
d. 200 m

Solution: (a)



Minimum angle for clear resolution,

$$\theta = 1.22\frac{\lambda}{\mathrm{a}}$$

$$distance = \mathrm{O_1O_2} = \mathrm{d}\theta$$

$$= 1.22\frac{\lambda}{\mathrm{a}}\mathrm{d}$$

$$distance = \mathrm{O_1O_2} = \frac{1.22 \times 5893 \times 10^{-10} \times 4 \times 10^{8}}{5} \approx 57.52\ \mathrm{m}$$

$\therefore$ *Nearest option is* 60 m

13. Photons of wavelength 6556 Å falls on a metal surface. If ejected electrons with maximum K.E moves in magnetic field of 3×10^{-4} T in circular orbit of radius 10^{-2}m, then work function of metal surface is

a. 1.8 eV
b. 0.8 eV
c. 1.1 eV
d. 1.4 eV

Solution: (c)

From photoelectric equation,

$$\frac{\mathrm{hc}}{\lambda} = \mathrm{W} + \mathrm{K.E}_{\mathrm{max}}$$

Where, hc = 12400 eV Å

$$\Rightarrow \frac{12400}{6556} = \mathrm{W} + \mathrm{K.E}_{\mathrm{max}}$$

$$\Rightarrow 1.9\ \mathrm{eV} = \mathrm{W} + \mathrm{K.E}_{\mathrm{max}} ------ (1)$$

Radius of charged particle moving in a magnetic field is given by

$r = \frac{mv}{qB}$ where, $\frac{1}{2}mv^2 = K.E_{max} = eV$

$\Rightarrow r = \frac{\sqrt{\frac{2eV}{m}} \times m}{eB} = \frac{1}{B}\sqrt{\frac{2mV}{e}}$

$\Rightarrow 10^{-2} = \frac{1}{3 \times 10^{-4}}\sqrt{\frac{2 \times 9.1 \times 10^{-31} \times V}{1.6 \times 10^{-19}}}$

$\Rightarrow V = 0.8\ V$

So, $K.E_{max} = 0.8\ eV$

Substituting in (1),

$1.9 = W + 0.8$

i.e. $W = 1.1\ eV$

14. Kinetic energy of the particle is E and it's De–Broglie wavelength is λ. On increasing it's K.E by ΔE, it's new De–Broglie wavelength becomes $\frac{\lambda}{2}$. Then ΔE is

a. 3E
b. E
c. 2E
d. 4E

Solution: (a)

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2m(KE)}}$$

$$\Rightarrow \lambda \propto \frac{1}{\sqrt{KE}}$$

$$\frac{\lambda}{\lambda/2} = \sqrt{\frac{KE_f}{KE_i}}$$

$$4KE_i = KE_f$$

$$\Rightarrow \Delta E = KE_f - KE_i = 4KE_i - KE_i = 3KE_i = 3E$$

15. The dimensional formula of $\sqrt{\frac{hc^5}{G}}$ is

a. $[ML^2T^{-3}]$
b. $[ML^2T^{-2}]$
c. $[ML^{-2}T^2]$
d. $[MLT^{-2}]$

Solution: (b)

$$E = \frac{hc}{\lambda}$$

$$\Rightarrow hc = E\,\lambda$$

$$Since, [E] = [ML^2T^{-2}]$$

Therefore,

$$[hc] = [ML^3T^{-2}]$$
$$[c] = [LT^{-1}]$$
$$[G] = [[M^{-1}L^3T^{-2}]$$
$$\left[\sqrt{\frac{hc^5}{G}}\right] = [ML^2T^{-2}]$$

16. Two immiscible liquids of refractive index $\sqrt{2}$ and $2\sqrt{2}$ are filled with equal height h in a vessel. Then apparent depth of bottom surface of the container given that outside medium is air

a. $\frac{3\sqrt{2}h}{4}$
b. $\frac{3h}{4}$
c. $\frac{3h}{2}$
d. $\frac{3h}{4\sqrt{2}}$

Solution: (a)

Apparent height as seen from liquid 1 (having refractive index $\mu_1 = \sqrt{2}$) to liquid 2 (refractive index $\mu_2 = 2\sqrt{2}$)

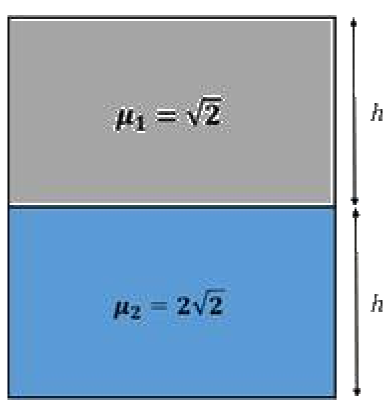
$\mathrm{D} = \frac{h\mu_1}{\mu_2} = \frac{h}{2}$

Now, Actual height perceived from air, $\mathrm{h} + \frac{h}{2} = \frac{3h}{2}$

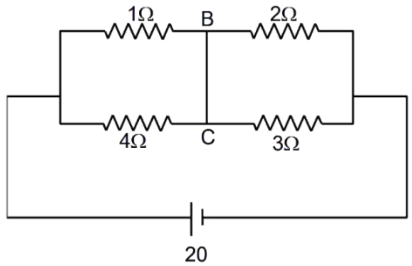
Therefore, apparent depth of bottom surface of the container (apparent depth as seen from air (having refractive index $\mu_0 = 1$) to liquid 1(having refractive index $\mu_1 = \sqrt{2}$)

$= \frac{3h}{2} \times \frac{\mu_0}{\mu_1}$

$= \frac{3h}{2} \times \frac{1}{\sqrt{2}} = \frac{3h}{2\sqrt{2}} = \frac{3\sqrt{2}h}{4}$



17. Find the current in the wire BC



a. 1.6 A
b. 2 A
c. 2.4 A
d. 3 A

Solution: (b)

Since resistance 1 Ω and 4 Ω are in parallel

$\therefore R' = \frac{4\times1}{4+1} = \frac{4}{5}$

Similarly we can find equivalent resistance (R'') for resistances 2 Ω and 3 Ω

$\Rightarrow R'' = \frac{6}{5}$

And R' and R'' are in series

$\therefore\ R_{eff} = \frac{4}{5} + \frac{6}{5} = 2\ \Omega$

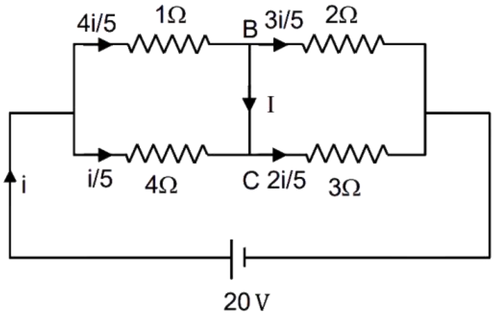
So total current flowing in the circuit 'i' can be given as

$$i = \frac{V}{R_{eff}} = \frac{20}{2} = 10\ A$$

Current will distribute in ratio opposite to resistance.

So, distribution will be as

So current in the branch BC will be



$$I = \frac{4i}{5} - \frac{3i}{5} = \frac{i}{5} = \frac{10}{5} = 2\ A$$

$$I = \frac{4i}{5} - \frac{3i}{5} = \frac{i}{5} = \frac{10}{5} = 2\ A$$

18. Two electromagnetic waves are moving in free space in x and y direction respectively whose electric field vectors are given by $\vec{E}_1 = E_o\hat{\jmath}\ \cos(kx - \omega t)$ and $\vec{E}_2 = E_o\hat{k}\cos(ky - \omega t)$. A charge q is moving with velocity $\vec{v} = 0.8c\ \hat{\jmath}$. Find the net Lorentz force on this charge at t = 0 and when it is at origin.

a. $qE_o(0.4\ \hat{\imath} + 0.2\ \hat{\jmath} + 0.2\ \hat{k})$
b. $qE_o(0.8\ \hat{\imath} + \hat{\jmath} + 0.2\ \hat{k})$
c. $qE_o(0.6\ \hat{\imath} + \hat{\jmath} + 0.2\ \hat{k})$
d. $qE_o(0.8\ \hat{\imath} + \hat{\jmath} + \hat{k})$

Solution: (b)

Given that the magnetic field vectors are:

$$\vec{E}_1 = E_o\hat{\jmath}\cos(kx - \omega t)$$
$$\vec{E}_2 = E_o\hat{k}\cos(ky - \omega t)$$

So the magnetic field vectors of the electromagnetic wave are given by

$$\vec{B}_1 = \frac{E_o}{c}\hat{k}\cos(kx - \omega t)$$
$$\vec{B}_2 = \frac{E_o}{c}\hat{\imath}\cos(ky - \omega t)$$

Then force is

$\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$

$\quad = q\left(\vec{E}_1 + \vec{E}_2\right) + q(\vec{v} \times (\vec{B}_1 + \vec{B}_2)$

Now if we put the values of $\vec{E}_1, \vec{E}_2, \vec{B}_1 and\ \vec{B}_2$ we can get the net Lorentz force as

$\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$

Putting values and solving we get

$\vec{F} = qE_o[\cos(kx - \omega t)\ \hat{\jmath} + \cos(ky - \omega t)\ \hat{k} + 0.8\cos(kx - \omega t)\ \hat{\imath} - 0.8(\cos ky - \omega t)\ \hat{k}]$

$\vec{F} = qE_o[0.8\cos(kx - \omega t)\ \hat{\imath} + \cos(kx - \omega t)\ \hat{\jmath} + 0.2(\cos ky - \omega t)\ \hat{k}]$

Now at $t = 0$ and $x = y = 0$ we get

$\vec{F} = (0.8\ \hat{\imath} + \hat{\jmath} + 0.2\ \hat{k})$

19. Two ideal di-atomic gases A and B. A is rigid, B has an extra degree of freedom due to vibration. Mass of A is m and mass of B is $\frac{m}{4}$. The ratio of molar specific heat of A to B at constant volume is

a. 7/9
b. 5/9
c. 5/11
d. 5/7

Solution: (d)

We know that,

Molar heat capacity at constant volume, $C_V = \frac{fR}{2}$ (Where f is degree of freedom)

Since, A is diatomic and rigid, degree of freedom for A is 5

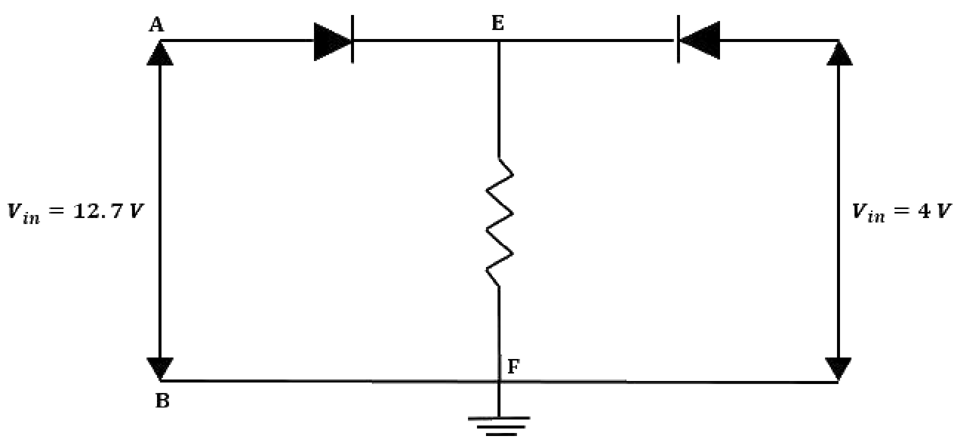
Therefore, Molar heat capacity of A at constant volume$(C_V)_A = \frac{5R}{2}$

Since, B is diatomic and have extra degree of freedom because of vibration, degree of freedom for B is $5 + 2\times 1 = 7$ (1 vibration for each atom).

Therefore, Molar heat capacity of B at constant volume$(C_V)_B = \frac{7R}{2}$

Ratio of molar specific heat of A and B= $\frac{(C_V)_A}{(C_V)_B} = \frac{5}{7}$

20. In the given circuit both diodes are ideal having zero forward resistance and built-in potential of 0.7 V. Find the potential of point E in volts

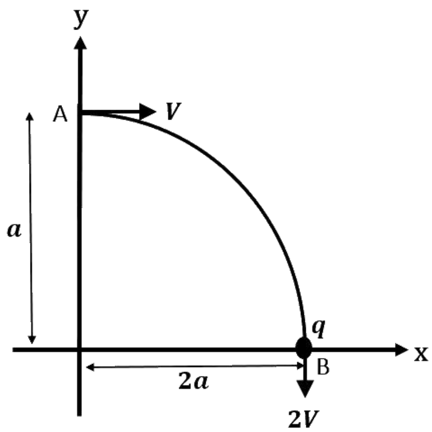


Solution: (12)

By applying Kirchhoff's Voltage Law in the loop ACBFA

$$12.7 - 0.7 - V_{EF} = 0$$
$$\Rightarrow V_{EF} = 12\ V$$
$$\Rightarrow V_E = 12\ V$$

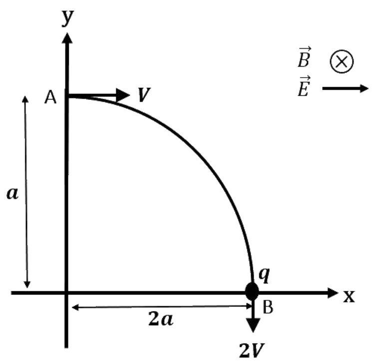
21. A particle having mass m and charge q is moving in a region as shown in figure. This region contains a uniform magnetic field directed into the plane of the figure, and a uniform electric field directed along positive x − axis. Which of the following statements are correct for moving charge as shown in figure?



A. Magnitude of electric field $\vec{E} = \frac{3}{4}\left(\frac{mv^2}{qa}\right)$
B. Rate of change of work done at a point A is $\frac{3}{4}\left(\frac{mv^3}{a}\right)$
C. Rate of change of work done by both fields at point B is zero
D. Change in angular momentum about the origin is $2mva$

a. A, B and C are correct
b. A, B, C and D are correct
c. A and B are correct
d. B, C and D are correct

Solution: (a)



Considering statement A
By Work-Energy theorem

$$W_{mag} + W_{ele} = \frac{1}{2}m(2v)^2 - \frac{1}{2}mv^2$$
$$\Rightarrow \qquad 0 + qE_o 2a = \frac{3}{2}mv^2$$
$$E_o = \frac{3}{4}\frac{mv^2}{qa}$$

So statement A is correct

Now considering statement B

Rate of change of work done at A = Power of electric force

$$= 9E_o v$$

$$= \frac{3}{4}\frac{mv^3}{a}$$

So statement B is correct

Coming to statement C

At B,

$\vec{E} \perp \vec{v}$

So, $\frac{dw}{dt} = 0$ for both forces

Coming to statement D.

Change in angular momentum about the origin is

$\Delta\vec{L} = \Delta\overrightarrow{L_B} - \Delta\overrightarrow{L_A}$

$\overrightarrow{L_B} = m(2v)(2a)$

$\overrightarrow{L_A} = m(v)(a)$

$Hence, \Delta L = 3mva$

22. If reversible voltage of 200 V is applied across an inductor, current in it reduces from 0.25A to 0A in 0.025ms. Find inductance of inductor (in mH).

Solution: (20)

By using KVL,

$$V - L\frac{dI}{dt} = 0$$

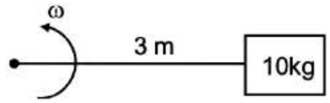
$$\Rightarrow 200 = \frac{L(0.25)}{0.025} \times 10^3$$

$$L = 200 \times 10^{-4} \text{ H}$$

$$= 20 \text{ mH}$$

23. A wire of length l = 3 m and area of cross section 10^{-2}cm^2 and breaking stress 4.8×10^8 N/m^2 is attached with block of mass 10 kg. Find the maximum possible value of angular velocity (rad/s) with which block can be moved in circle with string fixed at one end.

Solution: (4)



Breaking stress

$$\sigma = \frac{T}{A}$$

$$T = m\omega^2 l$$

$$\Rightarrow \sigma = \frac{m\omega^2 l}{A}$$

$$\Rightarrow \omega^2 = \frac{\sigma A}{ml} = \frac{4.8\times10^8\times10^{-6}}{10\times3} = 16$$

$$\Rightarrow \omega = 4\, rad/s$$

24. Position of a particle as a function of time is given as $x^2 = at^2 + 2bt + c$, where a, b, c are constants. Acceleration of particle varies with x^{-n} then value of n is

Solution: (3)

Let, v be velocity, α be the acceleration then,

$$x^2 = at^2 + 2bt + c$$

$$2\,x\,v = 2\,a\,t + 2\,b$$

$$x\,v = a\,t + b \qquad \text{\_\_\_\_\_\_}(1)$$

$$\Rightarrow v = \frac{at + b}{x}$$

Now, differentiating equation (1),

$$v^2 + \alpha x = a$$

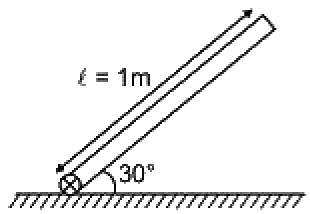
$$\alpha x = a - \left(\frac{at + b}{x}\right)^2$$

$$\alpha = \frac{a(at^2 + 2bt + c) - (at + b)^2}{x^3}$$

$$\alpha = \frac{ac - b^2}{x^3}$$

$$\alpha \propto x^{-3}$$

25. A rod of length 1 m is released from rest as shown in the figure below.



If ω of rod is $\sqrt{n}$ at the moment it hits the ground, then find n

Solution: (15)

: By using conservation of energy,

$$mg\frac{l}{2}\sin 30^\circ = \frac{1}{2}\frac{ml^2}{3}\omega^2$$

On solving

$\omega^2 = 15$

$\omega = \sqrt{15}$

Therefore, n = 15